

TANKLESS

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***Oversight
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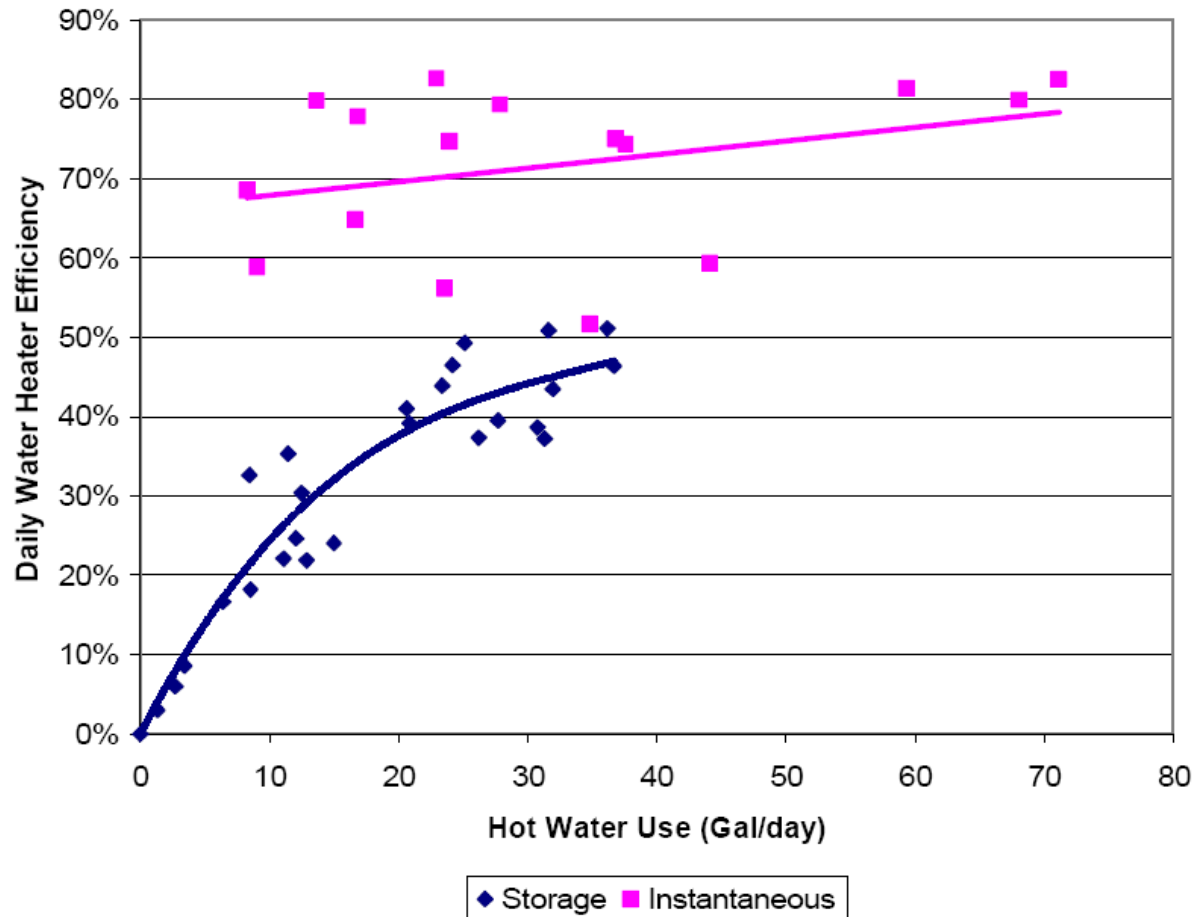
- Tankless
 - Positives
 - Negatives
- The Future
 - Emerging Trends
 - Research Issues

Positives

- Efficiency
 - High energy factors - 35 percent greater than storage type water heaters
 - No storage tank for minimal standby losses
 - No recovery and minimal heat loss on large fills
- Compact design
 - Small footprint / space requirements
 - Lightweight
 - Installation flexibility / Easy installation (new construction)
- Improved Performance
 - Continuous hot water delivery
- Applications
 - Domestic hot water
 - Hydronic heating
 - Combined space/water heating
 - Premium space installations

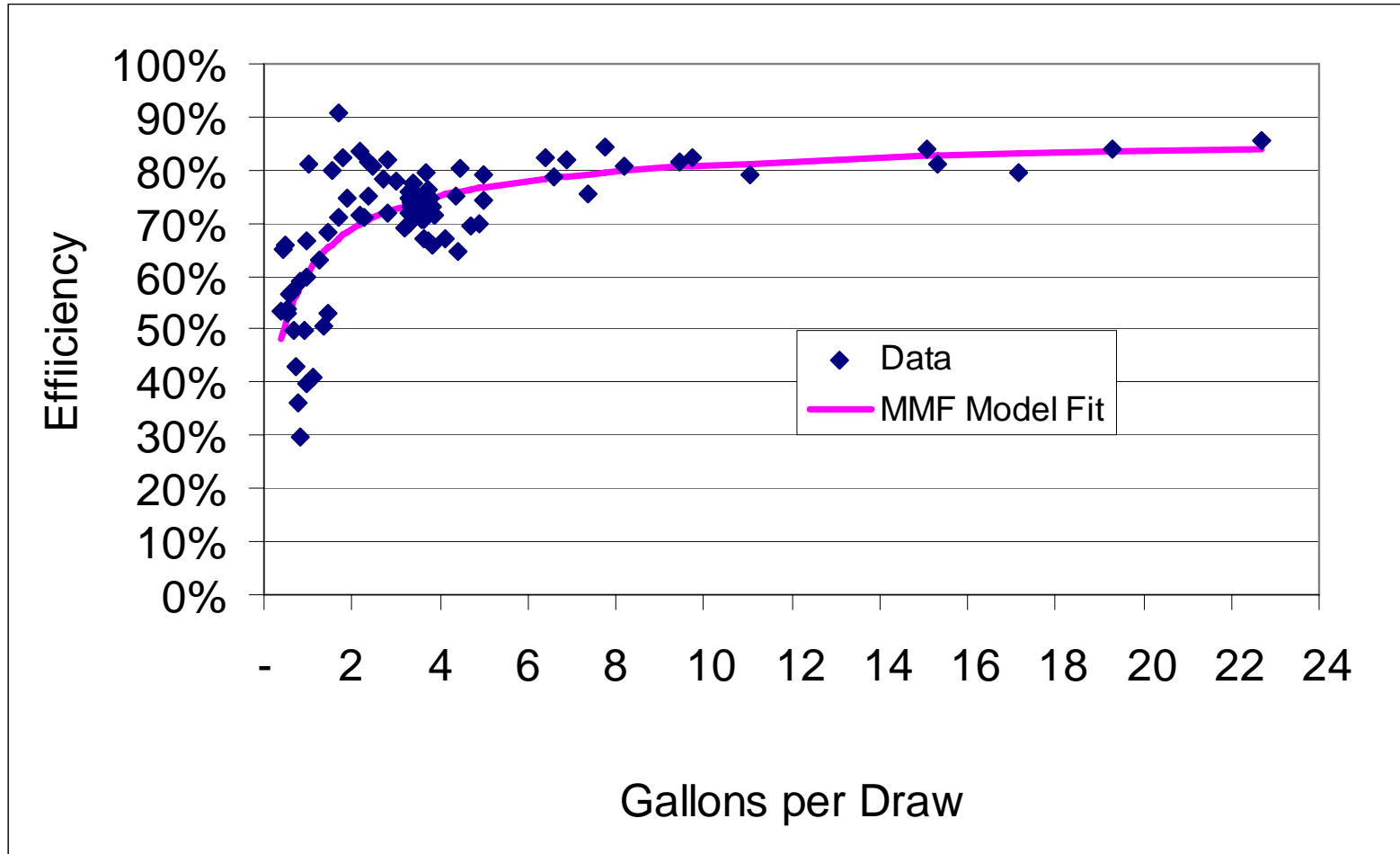
Efficiency

Figure 1: Field Measurements of Gas Storage and Tankless Water Heater Performance



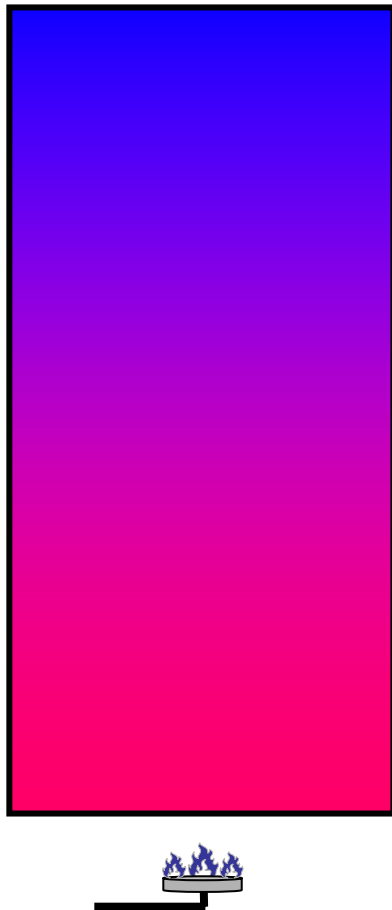
Measured Efficiency vs. Draw Volume

**Gas Tankless Water Heater Performance vs. Draw Size
(15 second monitoring interval)**



Compact Design

Big Tank, Small Burner



50 Gallon Storage

Weight: 150 - 175 lbs.

Dimensions:

64' H x 24' W x 24' D

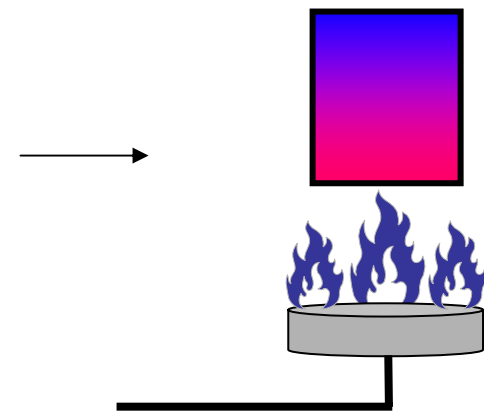
Tankless

Weight: 44 - 105 lbs.

Dimensions:

25' H x 20' W x 10' D

Big Burner, Small Tank



One Month Comparison

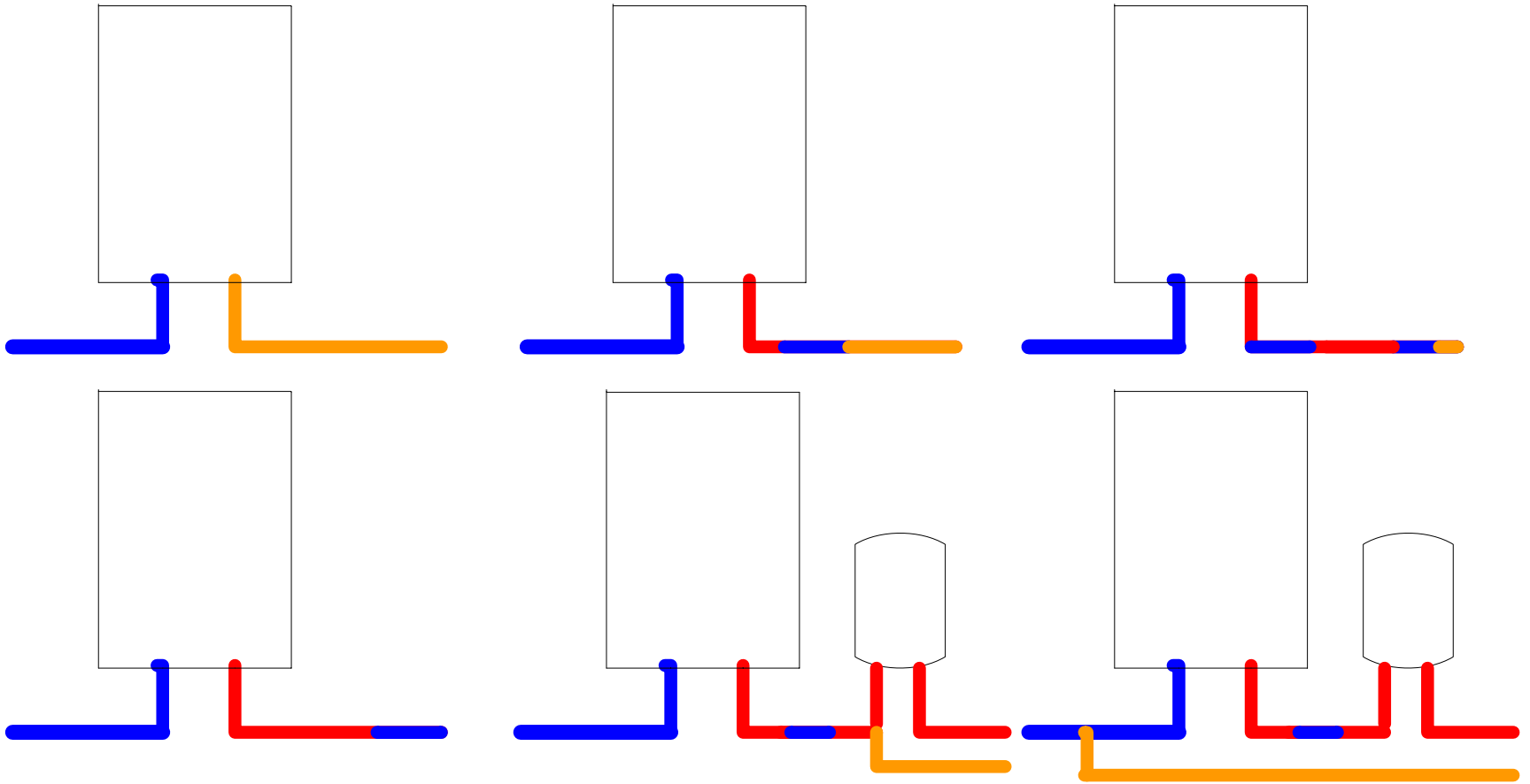
Parameter	Electric, 40-gallon tank	Natural gas-fired, 40-gallon tank	Natural gas-fired, Instantaneous
Total Quantity of Water Drawn (gallons)	1,896.0	1,896.0	1,896.0
Average Outlet Temperature (°F)	136.6	136.4	135.0
Electrical Energy Consumption (kWh)	332.9	N/A	0.6
Natural Gas Consumption (therms)	N/A	17.9	11.3
Total Energy Consumption (kBtu's)	1,136.29	1,793.74	1,130.55
Electrical Energy Cost (\$)	\$21.06	N/A	\$0.04
Natural Gas Cost (\$)	N/A	\$17.73	\$11.21
Total Energy Cost (\$)	\$21.06	\$17.73	\$11.25
Energy Factor	0.87	0.55	0.85

Source: Exelon Services Federal Group, December 2002

Negatives

- Installation
 - High first cost
 - Installation cost adders
 - Gas Piping
 - Electric
 - Venting
 - Non-qualified installs
- Operation
 - 5 to 15 second delay to set temperature
 - Minimum flow requirements rate 0.5 gpm
 - Incoming water temperature effects performance
 - Power requirement
- Servicing / Maintenance
 - Immature infrastructure
 - Complex systems
 - Critical periodic servicing required

Cold Water Sandwich



Cold Water Temperature Effects Performance

Manufacturer	Model	Energy Factor	Climate 35 F Cold Water	Climate 55 F Cold Water	Climate 75 F Cold Water
Gas Water Heater	40-Gal.	0.59	71%	71%	86%
Gas Water Heater	50-Gal.	0.57	79%	93%	93%
Bosch	38	0.66	0%	0%	0%
	125	0.78	0%	14%	50%
	240	0.81	36%	50%	79%
Paloma	PH12	0.65	0%	0%	14%
	PH24	0.63	36%	50%	79%
Rinnai	2424	0.82	36%	71%	100%
Takagi	TK1	0.79	36%	50%	79%
	TK2	0.81	36%	50%	100%
	TM1	0.79	50%	79%	100%

Maintenance Schedule

TANKLESS

Maintenance Task / Brand	A.O. Smith	Bosch	Bradford-White	Noritz	Paloma	Rheem	Rinnai	Takagi
INSPECT AND CLEAN WATER FILTER	1 Year	1 Year	1 Year	1 Year	Monthly	Monthly		1 Year
INSPECT AND CLEAN AIR FILTER					Monthly	Monthly		
INSPECT AND CLEAN BURNER	1 Year		1 Year	1 Year	1 Year	1 Year	1 Year	
TEST PRESSURE RELIEF VALVE	1 Year			1 Year	1 Year	1 Year	1 Year	1 Year
INSPECT VENT ASSEMBLY	1 Year	1 Year	1 Year	1 Year	1 Year	1 Year		1 Year
DE-LIMING			Sensor Code			Sensor Code	Sensor Code	
INSPECT PILOT ASSEMBLY		1 Year						
LUBRICATE WATER VALVE		2 Year						
REBUILD WATER VALVE		3-5 Years						

STORAGE

Maintenance Task	Storage
INSPECT AND CLEAN BURNERS	1 Year
TEST PRESSURE RELIEF VALVE	1 Year
INSPECT VENT ASSEMBLY	1 Year
CHECK TANK FOR LEAKS	1 Year
POST-WARRANTY ANODE INSPECTION	1 Year

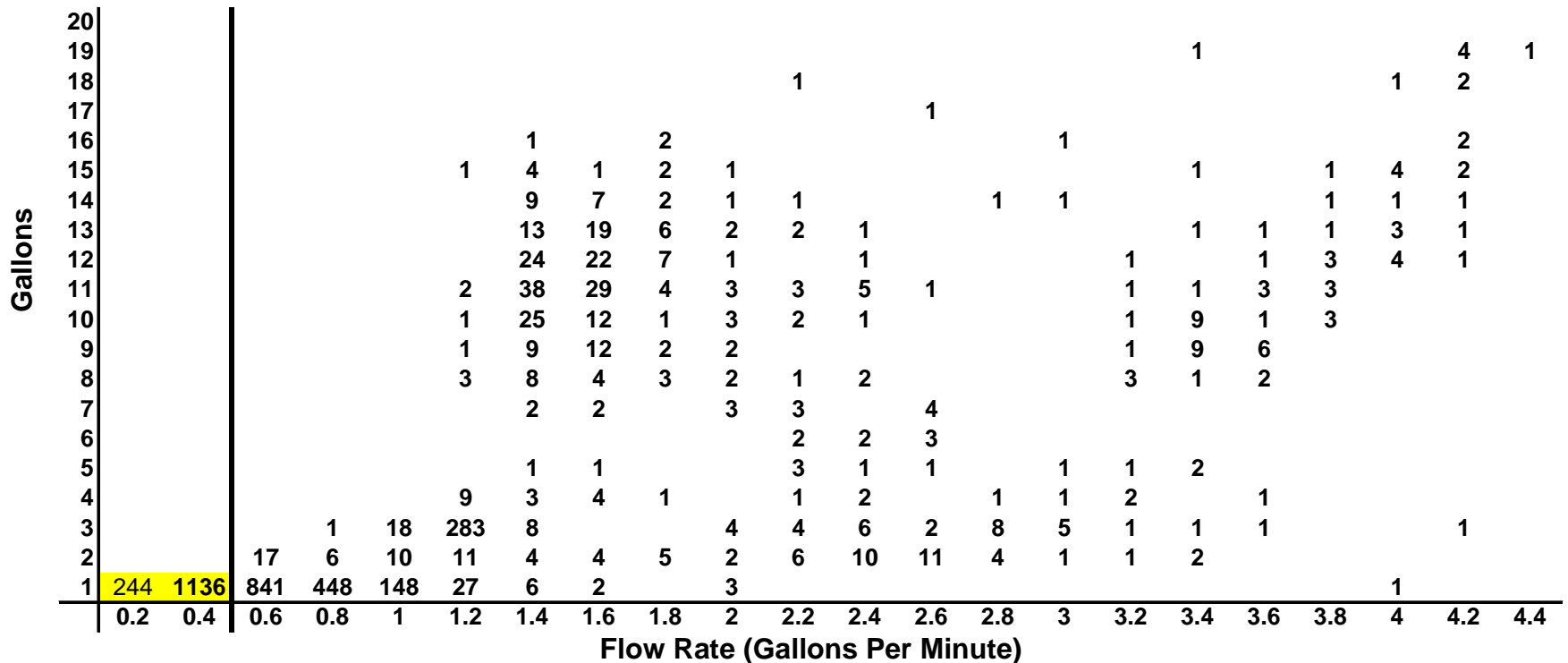
Warranty

Brand	Residential Water Heating Only	Residential Other	Commercial
Generic Gas Storage*	6/6-10/10	1/1 – 3/3	3/1
A.O. Smith	10/3		
Bosch	12/2	2/2	2/2
Bradford-White	10/5		5/5
Noritz	10/3	3/3	3/3
Paloma	10/3	1/1	3/1
Rheem	10/3	3/3	3/3
Rinnai	10/3	5/3	5/5
Takagi	7/2	7/2	7/2

(HX/Parts)

How is Hot Water Used

Bin Analysis of Weekday Water Draws for Residence



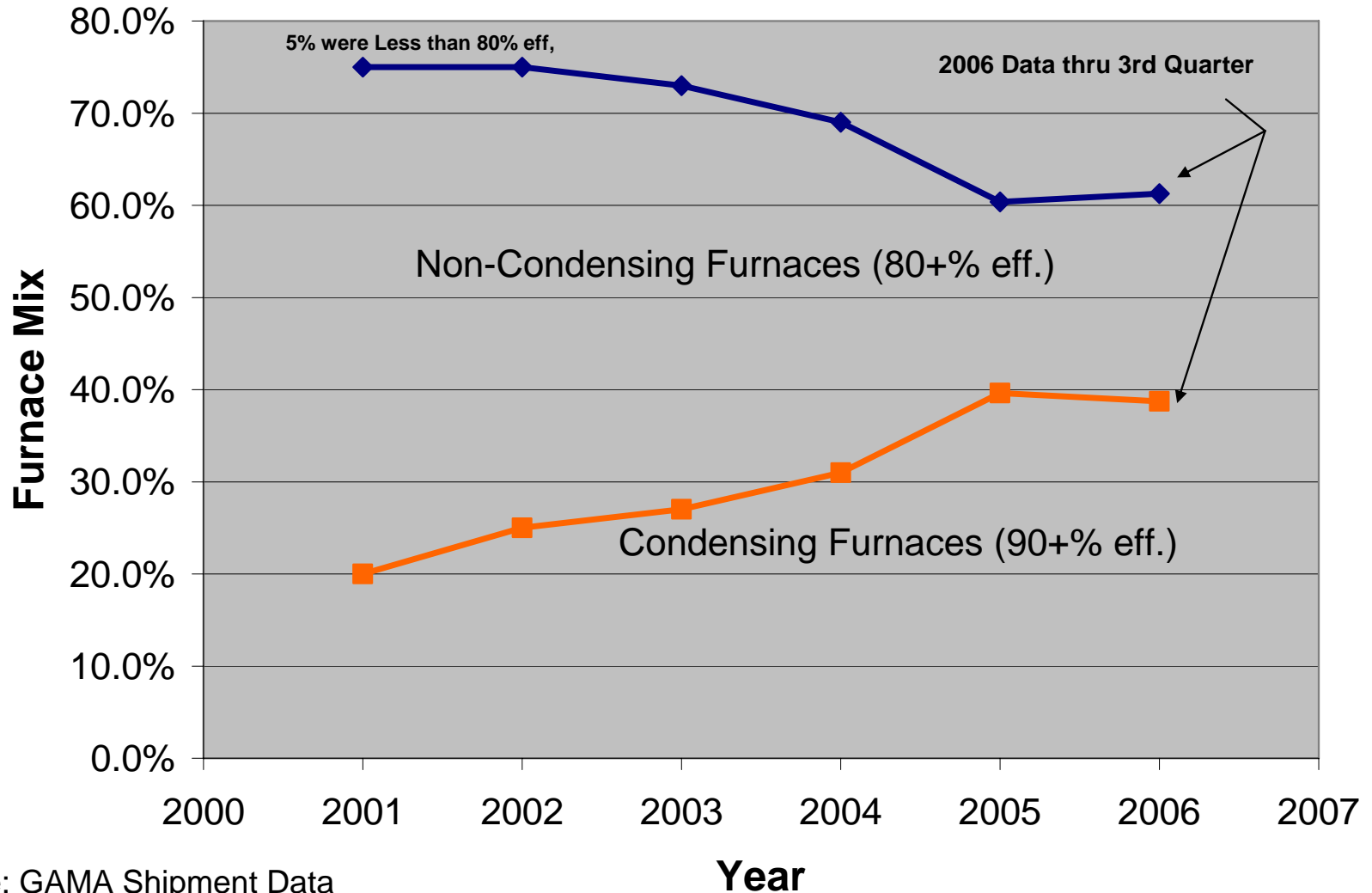
Gallons Wasted as a Function of Time and Fixture Flow Rate

(Green < 2 cups), Red > 1/2 Gallon)

	Time Until Hot Water Arrives (Seconds)															
	1	2	3	4	5	10	15	20	25	30	35	40	45	50	55	60
0.5	0.01	0.02	0.03	0.03	0.04	0.08	0.13	0.17	0.21	0.25	0.29	0.33	0.38	0.42	0.46	0.50
1	0.02	0.03	0.05	0.07	0.08	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.83	0.92	1.00
1.5	0.03	0.05	0.08	0.10	0.13	0.25	0.38	0.50	0.63	0.75	0.88	1.00	1.13	1.25	1.38	1.50
2	0.03	0.07	0.10	0.13	0.17	0.33	0.50	0.67	0.83	1.00	1.17	1.33	1.50	1.67	1.83	2.00
2.5	0.04	0.08	0.13	0.17	0.21	0.42	0.63	0.83	1.04	1.25	1.46	1.67	1.88	2.08	2.29	2.50
3	0.05	0.10	0.15	0.20	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00
3.5	0.06	0.12	0.18	0.23	0.29	0.58	0.88	1.17	1.46	1.75	2.04	2.33	2.63	2.92	3.21	3.50
4	0.07	0.13	0.20	0.27	0.33	0.67	1.00	1.33	1.67	2.00	2.33	2.67	3.00	3.33	3.67	4.00
4.5	0.08	0.15	0.23	0.30	0.38	0.75	1.13	1.50	1.88	2.25	2.63	3.00	3.38	3.75	4.13	4.50
5	0.08	0.17	0.25	0.33	0.42	0.83	1.25	1.67	2.08	2.50	2.92	3.33	3.75	4.17	4.58	5.00
5.5	0.09	0.18	0.28	0.37	0.46	0.92	1.38	1.83	2.29	2.75	3.21	3.67	4.13	4.58	5.04	5.50
6	0.10	0.20	0.30	0.40	0.50	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50	5.00	5.50	6.00
6.5	0.11	0.22	0.33	0.43	0.54	1.08	1.63	2.17	2.71	3.25	3.79	4.33	4.88	5.42	5.96	6.50
7	0.12	0.23	0.35	0.47	0.58	1.17	1.75	2.33	2.92	3.50	4.08	4.67	5.25	5.83	6.42	7.00
7.5	0.13	0.25	0.38	0.50	0.63	1.25	1.88	2.50	3.13	3.75	4.38	5.00	5.63	6.25	6.88	7.50
8	0.13	0.27	0.40	0.53	0.67	1.33	2.00	2.67	3.33	4.00	4.67	5.33	6.00	6.67	7.33	8.00
8.5	0.14	0.28	0.43	0.57	0.71	1.42	2.13	2.83	3.54	4.25	4.96	5.67	6.38	7.08	7.79	8.50
9	0.15	0.30	0.45	0.60	0.75	1.50	2.25	3.00	3.75	4.50	5.25	6.00	6.75	7.50	8.25	9.00
9.5	0.16	0.32	0.48	0.63	0.79	1.58	2.38	3.17	3.96	4.75	5.54	6.33	7.13	7.92	8.71	9.50
10	0.17	0.33	0.50	0.67	0.83	1.67	2.50	3.33	4.17	5.00	5.83	6.67	7.50	8.33	9.17	10.00

1 cup = 8 ounces = 1/16th gallon = 0.0625 gallon

Market Trends



Water Quality

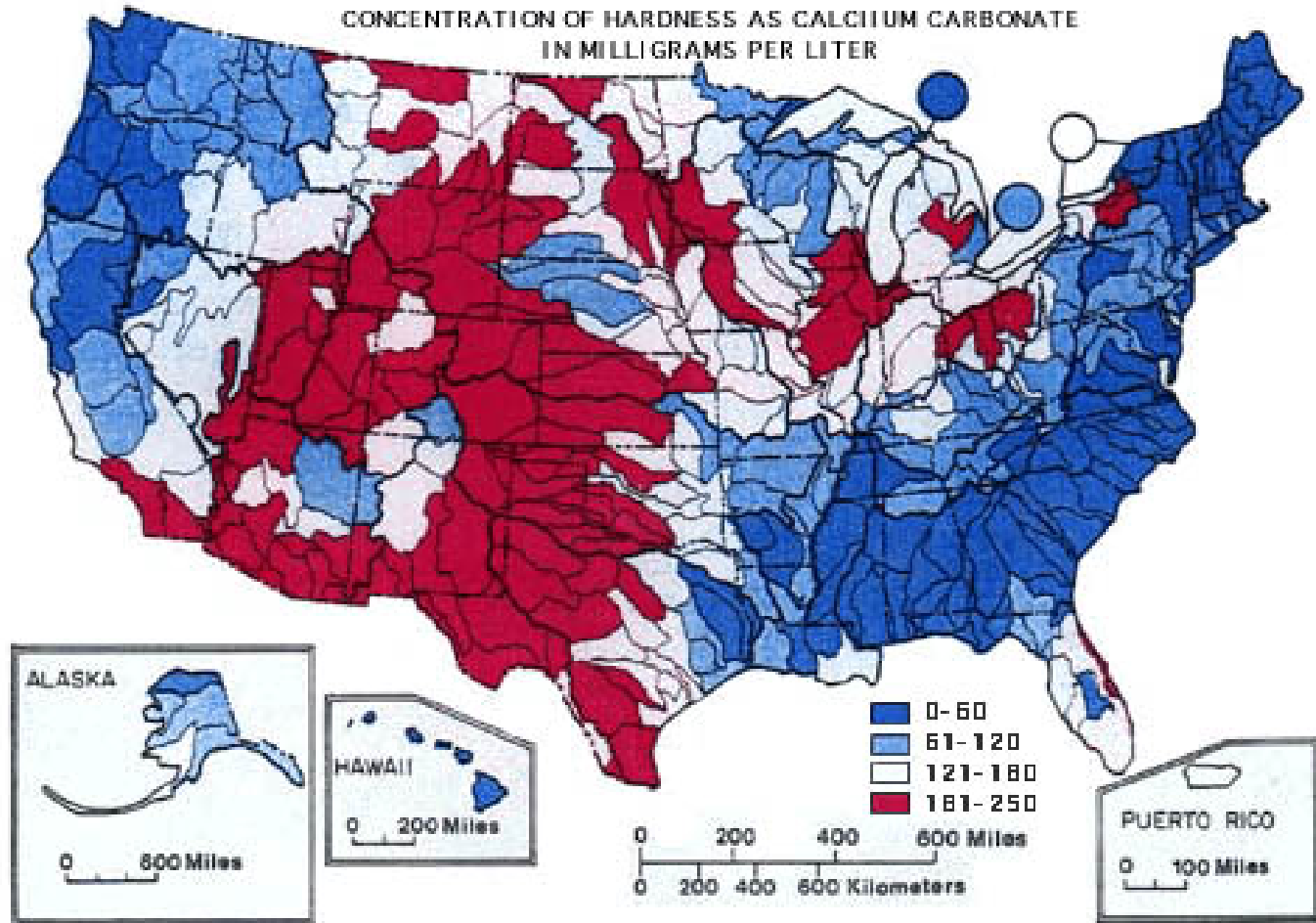
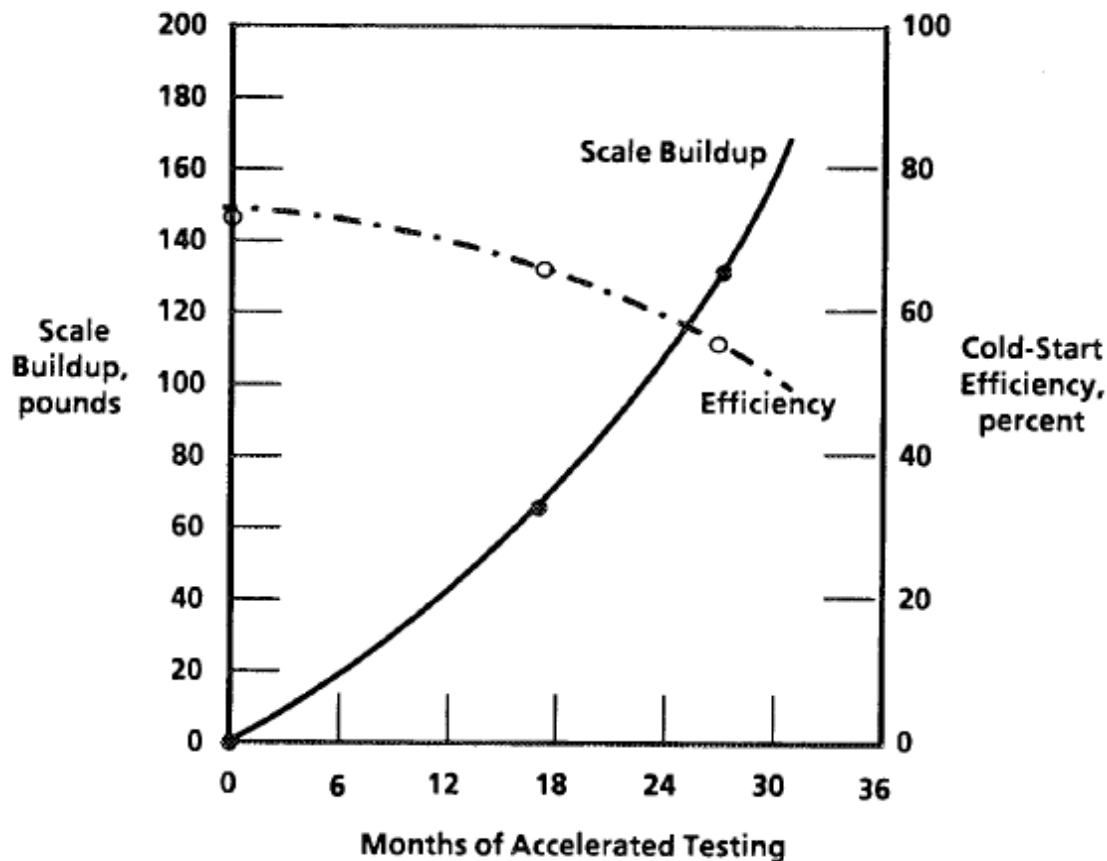


Figure 5.—Mean hardness as calcium carbonate at NASQAN stations during 1975 water year. Map at bottom is colored to show station data representing flow from the accounting unit.

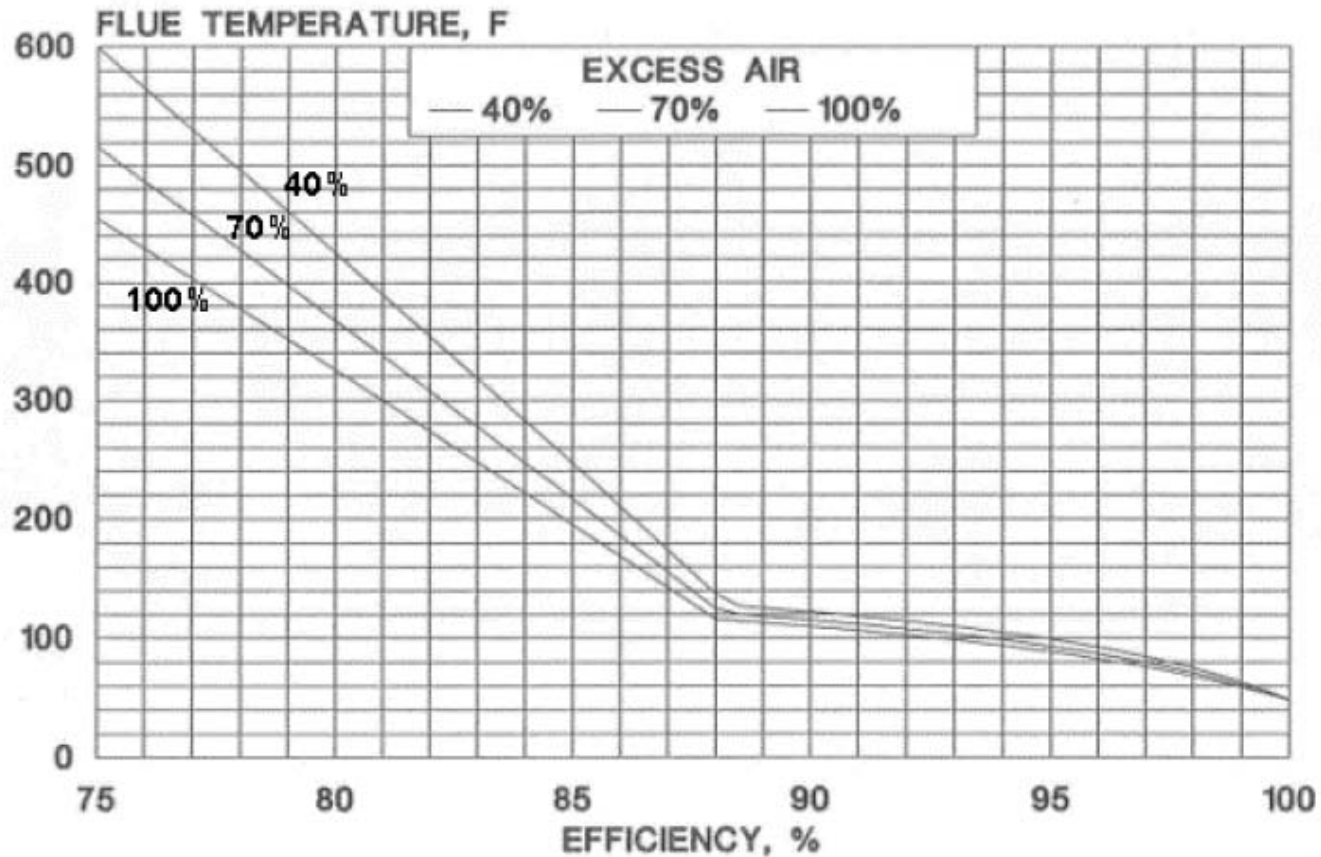
Scale Build-Up Effects on Water Heater Efficiency



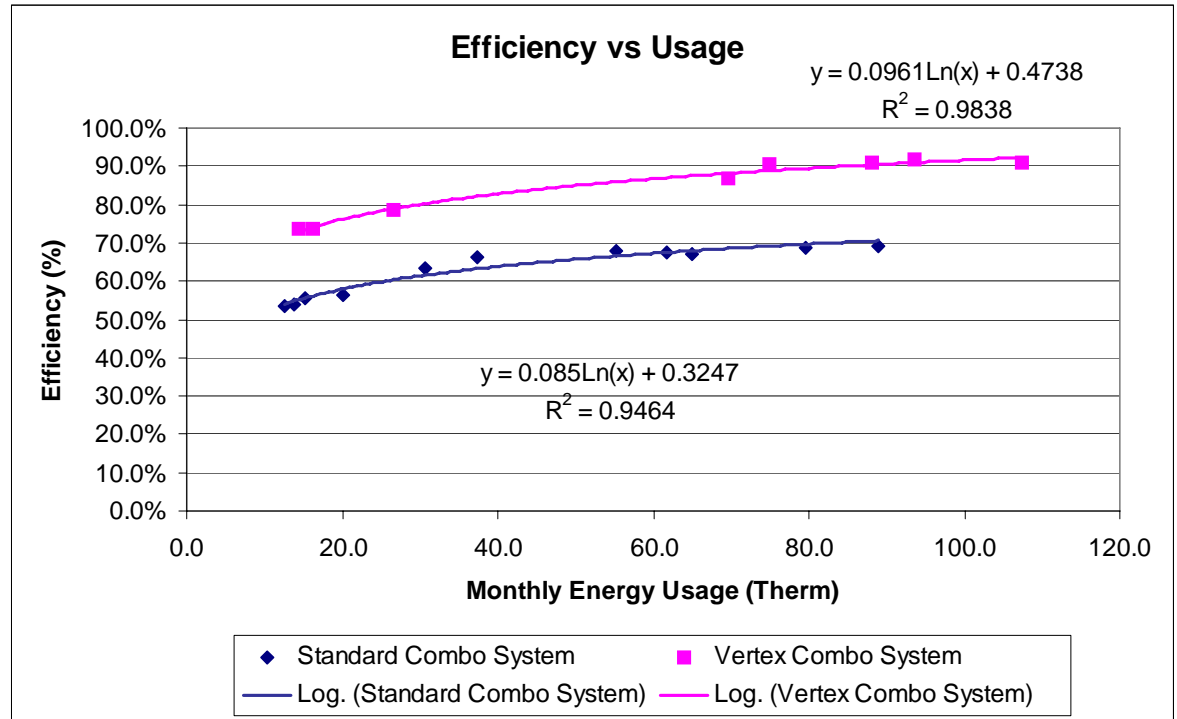
Methods to Prevent Scale

- Water Conditioners
- Water Softeners
- Water Distillers
- Reverse Osmosis
- **Mechanical Precipitators**
- **Catalytic Systems**
- **Electric Field Generators**

New Heat Exchanger Materials, Coatings and Designs



Emerging Competition



Structured Plumbing Layout

Using a Dedicated Return Line

